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Editorial

Special Issue "Salinization of Water Resources: Ongoing and Future Trends"

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1. Introduction

All over the Earth, more and more studies have shown the effects of climate changes generated by anthropic release of greenhouse gasses on the hydrological cycle [1,2]. These have induced changes in precipitation patterns as well as changes in actual and potential evapotranspiration [3], which in turn may decrease the recharge rates towards the aquifers while increasing the surface runoff towards the oceans [4–6]. Within this changing framework, the salinization of water resources has been already recognized as a widespread phenomenon affecting many areas throughout the globe, especially in coastal environments [7–9]. The already increased demand of freshwater triggered by climate change and the consequent land use changes, has intensified the research on water resources salinization and the feasible techniques aimed at mitigating such effects, such as for example the wastewater reuse via managed aquifer recharge systems [10,11]. Recently the research efforts on the effects of climate change have seen a shift from the above ground components towards the subsurface components of the hydrologic cycle [12]. Nevertheless, substantial gaps have to be filled yet to fully understand the impact of climate change on groundwater quality and the interconnected groundwater dependent ecosystems. To tackle this complex problem holistic approaches can be employed using different techniques such as remote sensing, hydrogeological, geophysical and geochemical techniques. The different kind of acquired data can then be employed to calibrate and validate process based numerical models, which are robust tools to improve our subsurface conceptual models necessary to manage the ongoing and future water resources use. The limited understanding of the ongoing and future effects of climate change on groundwater quality has therefore motivated the conception of this Special Issue.

2. Contributions

The principal objective of this Special Issue of Water is to present the latest research on the quantification of surface and groundwater salinization processes in the surface water–soil–aquifer continuum. The most susceptible zones to such processes are coastal areas, which are also the most populated regions of the Earth. In such areas, the significant increases in sea level and atmospheric temperatures due to climate change could exacerbate water resources salinization. However, even areas distant from the sea can be threatened by water resource salinization, for example: in arid areas evapoconcentration processes can lead to salt accumulation and soil salinization; while in mining areas formation waters are pumped away for excavation purposes can threaten surface waters. From its first announcement, and after being thoroughly peer-reviewed, seven papers have been accepted for publication [13–19]. The contributions come from field studies scattered around the world, with 3 papers from Italy, 1 from Australia, 1 from China, 1 from Ecuador and 1 from Argentina; highlighting that these problems are already affecting the

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whole world. To obtain a full comprehension of the ideas collected by this Special Issue, a brief synopsis of each published paper is reported here below.

A field and numerical study on the actual and predicted salinization processes in the Volturno River mouth (Southern Italy), which hosts a fragile nature reserve highly sensitive to salinity variations has been published as the first paper of this Special Issue [13]. The results of this study highlighted that the predicted changes in recharge or evapotranspiration will not dramatically increase the groundwater salinization at this site, while an increase of the seawater wedge is forecasted by forcing the model with the higher range of IPCC predicted sea level rise. Another field study located in the low-lying coastal area of Ravenna (North-eastern Italy) focused on statistical analysis of the water drainage long-time series (1971–2017) to identify and assess salinization factors [14]. The results showed that subsidence rates and seepage from the unconfined aquifer are the most significant salinization factors. The trend data analysis also indicated that the climate, played a minor role during the studied time interval, while over pumping for land reclamation could exacerbate water salinization. The third paper published in this Special Issue provided a background to the salinity issue in the Murray–Darling Basin (Australia), then reviewed the salinity management strategies, the various actions that have been implemented through these strategies to control salinity, and the role of the recent Basin Plan in salinity management [15]. Another contribution of this Special Issue tackled soil salinity determination via hyperspectral data measured using an analytical spectral device field spectrometer and satellite sensor visible shortwave infrared advanced hyperspectral imager. The comparison of the two techniques were consistent when the soil salinity was relatively low (1–10 g/kg) and thus providing promising results to obtain cost effective mapping of soil salinity in inaccessible areas [16]. On a different line of research, the study presented by Carrión-Mero et al. [17] analyzed the Manglaralto coastal aquifer (Ecuador), which is affected by water resource scarcity, with a variable density flow and transport model individuating the key zones for artificial recharge. Another important contribution of this Special Issue used a holistic approach (lithological, hydrochemical, isotopic and geophysical surveys) to study the salinization processes affecting Pleistocene and Holocene beach ridges of the northern Patagonian coast [19]. Finally, a field study located between the margin of the Southern Venice lagoon and the Northern Po delta (Italy), closes this Special Issue. This study proposed a new vulnerability assessment method to land salinization, combining the depth of the freshwater/saltwater interface and the electrical resistivity of the shallow subsoil that could be widely used in low ling areas [19].

I sincerely hope that, with the papers published in this Special Issue, the topic of salinization of water resources will collect more and more consideration by the specialized and general scientific community throughout the world.

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